USER MANUAL

STM32 Based LED Matrix Display Demo

Introduction

This user manual describes the operation of STM32 based LED Matrix Display Demo board.

This board demonstrates the capability of STP16DP05 LED driver to drive the matrix LED panel. The complete system includes one master board, one slave board and LED Matrix Display panels. Master and slave boards are STM32 microcontroller based control units which are used for configuring the display settings for STP16DP05 display driver.

This unit has a GPS module interfaced to it through an USART port. The GPS data can be displayed with information of latitude and longitude and also the real time clock. The display can be configured for any of the nine different display modes and nine different speeds using a PS2 keyboard. Display panels can also be configured through the HyperTerminal using the serial interface present on control units. System also consists of audio out for playing back the .wav file pre recorded in micro sd card.

Figure 1 LED Matrix Control Unit

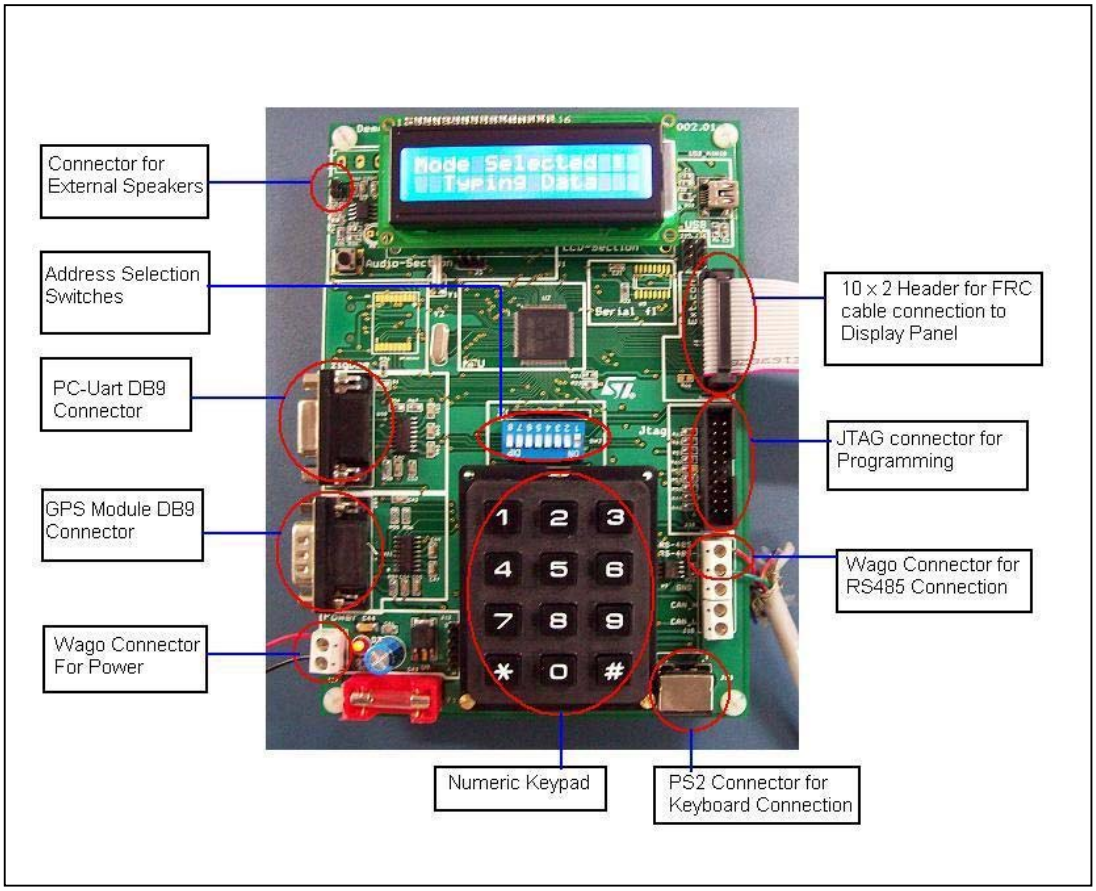
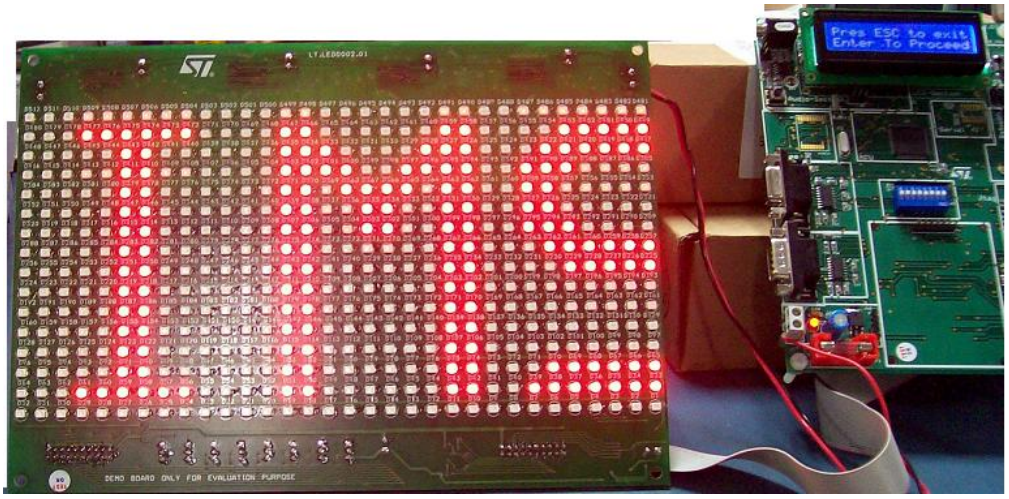

Connector for External Speakers
Address Selection Switches
PC-Uart DB9 Connector
GPS Module DB9 Connector
Wago Connector For Power
10 x 2 Header for FRC cable connection to Display Panel
JTAG connector for Programming
Wago Connector for RS485 Connection
Numeric Keypad
PS2 Connector for Keyboard Connection

Figure 2.LED Display Panel



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1 Getting Started

1.1 Package Contents

STM32 based led matrix display demo package consists of the hardware and supporting document.

- **Hardware:** One demonstration mother board + One LED Matrix Display Panel
- **Documentation :** User Manual for operating the demonstration board.

1.2 Hardware Description

This complete system has one control unit and a display unit.Control Unit is microcontroller based demo board and display unit is LED MATRIX board.

Major Components on Control Unit are:

- STM32F103VBT6, 32-bit Microcontroller
- ST485ABDR, RS485 Transceiver
- LD1086D2T33TR, Voltage Regulator
- ST3232BDR, RS232 Transceiver
- TS461CLT, Rail to rail operational amplifier
- TDA2822D, post amplifier
- STM1001RW6XF, Reset IC
- STPS1L30A, Schottky diode
- ESDALC6V1W5,ESD protection device
- 16 x 2 Alphanumeric LCD
- Mini USB connector
- External Power Supply Screw type Connector

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Major Components on Display Unit are:

- STP16DP05MTR, Display Driver
- TIP105, Darlington pair
- 74VHC24MTR, Buffer
- 16 x 32 LED Matrix

1.3 Power Supply Unit

Power supply for control unit is 5Volt – 0.5Amps DC and for each Display board it is 3.5V -5Volt / 3Amps DC.

Both control unit and display unit are having one screw type connector each for power supply connection. Figure 3 shows the power supply connection for Control Unit and Figure 4 shows the power supply connection for display unit. In each display panel there are 2 screw type connectors for power connection. VCC+5V0 and GND are mentioned on each of these connectors. Power can be be

applied to any one of these two connectors to power the LED panel. Each panel is to be powered externally and individually.

Figure 3. Power Supply Connection On Control Unit

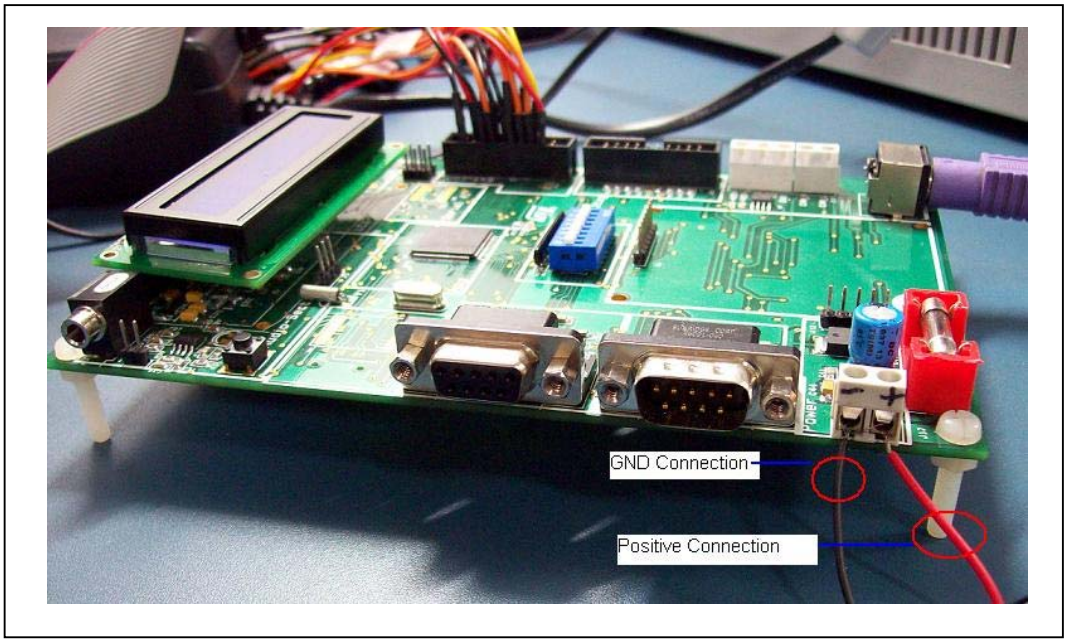
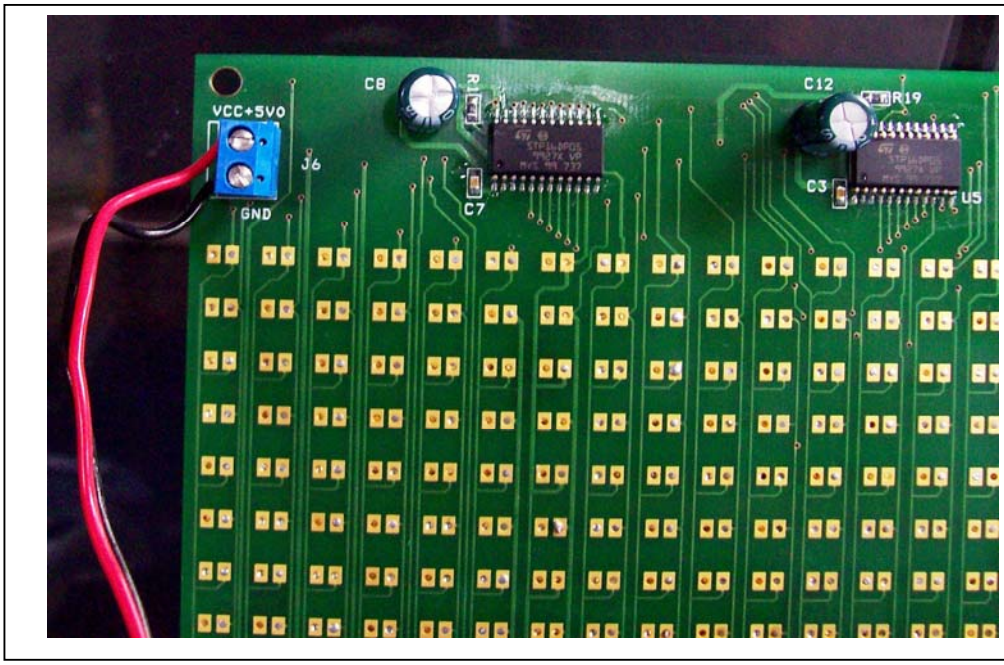


Figure 4. Power Supply Connection for LED Display Panel



2 Description Of System

This STM32 based display demo system is having a microcontroller based control unit and a LED driver based display unit. Control unit is used for configuring the display driver and display unit is used for controlling the LED display in accordance to the configuration received from control unit.

2.1 Description of Microcontroller based Control Unit

Control unit is STM32 microcontroller based board. This board has interfaces for :

- PS2 keyboard
- DB9 (Female) connector for PC serial port (UART) connection
- DB9(Male) connector for serial (UART) connection to GPS module
- Onboard Numeric Keypad
- Audio Jack and also 2 pin connector for external speaker
- Screw type connector for RS485 communication between master and slave control units.
- 10 x 2 header (Ext.Con) for flat ribbon cable connection to display unit.
- Slot for micro SD card
- Screw type connector for 5V DC power connection

This microcontroller based unit is used to control the display board. This unit can be configured to operate as master (responsible for sending the commands for dipaly control) or as slave unit (responsible for receiving the commands and executing it on display unit). In every system one control unit acts as a master.

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2.1.1 Address Configuration Of Control Unit

Each control unit is having 8 dip switches (SW2). These switches are used to configure the address for the control unit.

Address configuration for control unit is done by moving the switches either to high or to low positions.

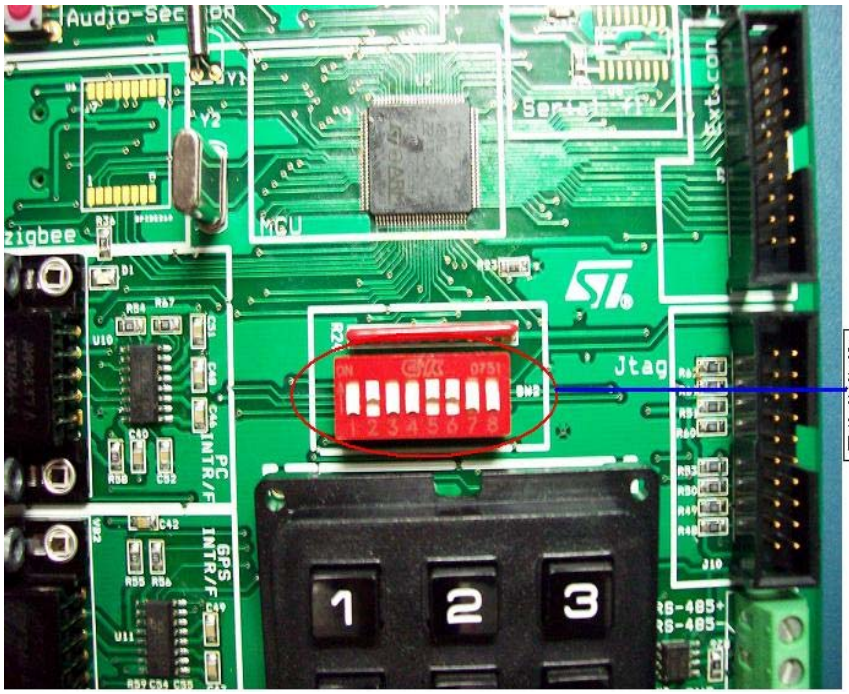
Eight I/O lines are used for address allocation to the control unit. Thus upto 255 addresses can be assigned to any control board. Board can have any address between 0 and 255.

If switch is slided towards the side where numbers are written then logic ‘1’ is assigned to the port and if the switch is slided towards the side where “ON” is written then logic ‘0’ is assigned to the board.

Whenever the board is powered up and is connected as slave unit then its address will be displayed on the LCD mounted on board. Figure 5 shows on board switches.

Note: Address 255 is hardcoded to master unit and no slave unit is allowed to have this address. Thus one should never slide all the 8 switches to the side where numbers are written(opposite to side where “ON” is written)

Figure 5. Slave Unit Address Configuration Switches



2.1.2 Selecting the Control Unit as Master or Slave

Any control unit can act as master or slave. On-board keypad is used to configure the control unit as Master or as Slave.

Below are the steps for configuring the control unit:

- Connect 5 volt power supply to control unit (as explained in section 1.3)
- LCD will display “Press # to enter Configuration Mod” for 4 seconds
- Press “#” on keypad present on board. LCD will show “Master Sel: Entr*1” and “Slave Sel: Entr *2”
- To configure the board as Master press “*1” or to configure the board as Slave press “*2” on keypad
- If “*1” was pressed then LCD will show “MASTER BOARD” for 2 seconds and then start the Master routine on board
- If “*2” was pressed then LCD will show “SLAVE BOARD” for 2 seconds and then start the Slave routine on board.
- On next power up of board LCD will again show the message “Press # to enter Configuration Mod” for 4 seconds but if “#” is not pressed in 4 seconds then board will enter in the mode which was configured last time.

2.2 Description of LED Driver based Display Unit

Display unit is STP16DP05MTR LED display driver based panel.

Each display panel is having four STP16DP05MTR LED display drivers, two buffers, eight darlington pair and a matrix of16 x32 LED’s. Each pannel can be connected in series to make a larger display. This series connection between the display panels is through 10 x 2 header. 20 pin flat ribbon cable is used to connect two display panels.Input to display panel is coming from control unit through 20 pin Flat ribbon cable. Thus first display panel is connected to control unit to receive the data and also to next display panel to cascade the data further. Total 8 such pannels can be cascaded in series.

Figure 6 shows the connection of Display panel. First panel is connected at both side, one to control unit using 20 pin cable between **Ext Con** header on control unit and **INPUT** header at display panel and other side to second display panel using **OUTPUT** header at first panel and **INPUT** header at second panel.

Note:Length of the flat ribbon cable (FRC) should not be exceeded 30 cm.

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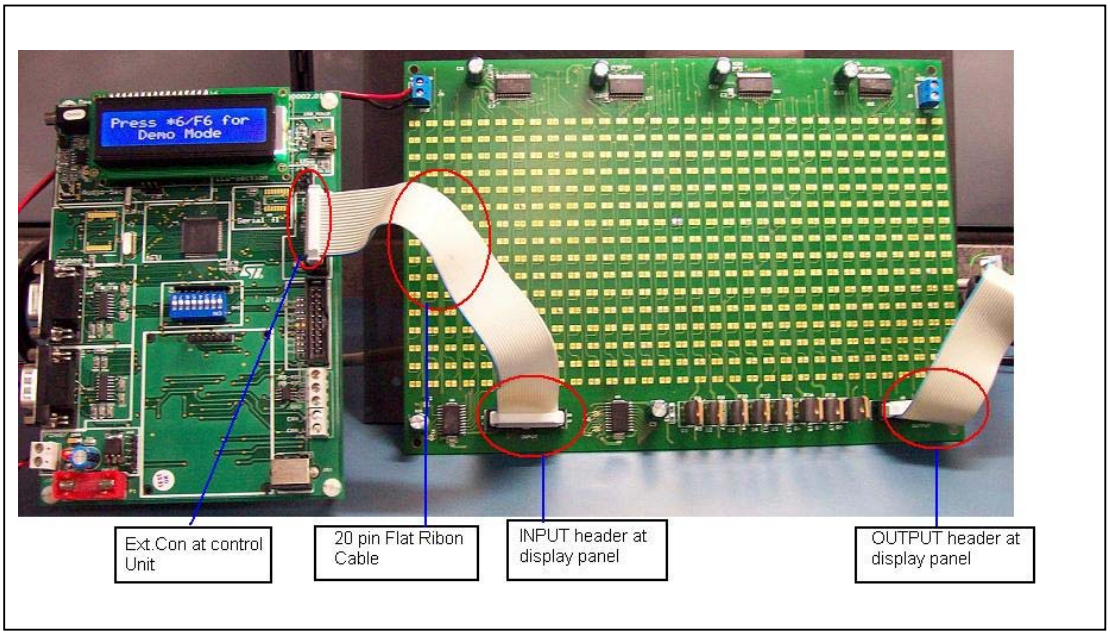
Figure 6.Connection of Display panels


Press *6/F6 for
Demo Mode
Ext.Con at control Unit
20 pin Flat Ribon Cable
INPUT header at display panel
OUTPUT header at display panel

3 Configuration of System

Whole system can be connected in one of the following configurations:

1. One control Unit and one display unit without a slave unit
2. Two control units (one acting as a master and other as slave) and one display unit
3. Multiple control units (one acting as a master and rest other as slaves) and multiple display units (each display unit connected to each slave. One display unit can have up to 8 cascaded panels that could be controlled by a single slave unit.)

3.1 One Control Unit and One Display Unit Configuration

In this configuration there is single control unit and a single display unit. Control unit will act as master.

Below are the steps to operate the system in this configuration:

Step 1: Connect PS2 keyboard to the control unit

Step 2: Connect the control unit with display panel using 20 pin flat ribbon cable. Insert the cable in 10 x 2 header **(Ext.Con)** present on master at one side and in header J1 **(INPUT)** on display panel at other side.

If needed display panels can be cascaded in series to make a longer display. To cascade display panels connect 20 pin flat ribbon cable from jumper J3 **(OUTPUT)** of first panel to jumper J1 **(INPUT)** of second panel. Figure 6 shows connections for cascading of display panels. Similarly connect frc cable from jumper J3 **(OUTPUT)** of second panel to jumper J1 **(INPUT)** of third panel and so on to make a longer display. Up to 8 such display panels can be cascaded in series.

Step 3: Connect the power to master control unit and to display panel as explained in section1.3

Step 4: LCD on master control unit will show ""Press # to enter Configuration Mod" for 4 seconds

Step 5: Press "#" on keypad present on board.If 4 seconds has elapsed and the board was not configured then it will enter in the mode which was last configured. To again configure it press reset button.

Step 6: If "#" was pressed then LCD will show "Master Sel: Entr*1" and "Slave Sel: Entr *2"

Step 7: Press "*1" on keypad. LCD will show "MASTER BOARD"

Step 8: After 2 Seconds LCD will start the demo showing "Led Matrix Demo"

Step 9: Display will start showing 4 options:

1) "Press F1 For PC – UART Comm"
2) "Press F2 For GPS Data Display"
3) "Press F3 For Typing Data"
4) "Press F6 For Demo Mode"

Step 10: Press F1 or F2 or F3 or F6 on keyboard to select one of the above mentioned modes.

Step 11: Based on which of the above mentioned key is pressed, system will enter in one of the above mentioned modes. Operation in each mode is explained in section 4

Step 12: Press ESC on keyboard to exit from the selected mode.

Step 13: Once exited from the selected mode, system will resume from step 9

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3.2 Two Control Units and One Display Unit Configuration

In this configuration there are two control units and a single display unit. One Control unit should be master and other one should be slave. By default system comes with one master and one display panel.

Below are the steps to operate the system in this configuration:

Step 1: Configure one control unit as Master and other control unit as Slave as explained in section 2.1.2

Step 2: Configure the address of Slave board using the onboard DIP switches as explained in section 2.1.1

Step 3: Connect PS2 keyboard to the master control unit

Step 4: Connect display panel to Slave control unit using 20 pin flat ribbon cable. Insert the cable in 10 x 2 header **(Ext.Con)** present on slave at one side and in header J1 **(INPUT)** on display panel at other side.

If needed display panels can be cascaded in series to make a longer display. To cascade display panels connect 20 pin flat ribbon cable from jumper J3 **(OUTPUT)** of first panel to jumper J1 **(INPUT)** of second panel. Figure 6 shows connections for cascading of display panels. Similarly connect frc cable from jumper J3 **(OUTPUT)** of second panel to jumper J1 **(INPUT)** of third panel and so on to make a longer display. Up to 8 such display panels can be cascaded in series.

Step 5**: Connect Master and Slave control unit using twisted pair cable. Ensure that RS485+ at master is connected to RS485+ at slave and RS485- at master is connected to RS485- at slave. Connections are made at screw type connector (J18).**

Figure 7 shows the RS485 connection

Step 6.Power up master control unit, slave control unit and Display panel using DC power supplies

Step 7: LCD on master and slave control unit will show “Press # to enter ConfigurationMod”. If master and slave boards are already configured (in step 1) then don’t press “#” and boards will resume its functionality in 4 seconds.

Step 8: Master control unit will start the demo showing “Led Matrix Demo” and slave control unit will start showing its own address.(Address is configured using on board switches).

Step 9: Display at master will start showing 4 options:

1) “Press F1 For PC – UART Comm”
2) “Press F2 For GPS Data Display”
3) “Press F3 For Typing Data”
4) “Press F6 For Demo Mode”

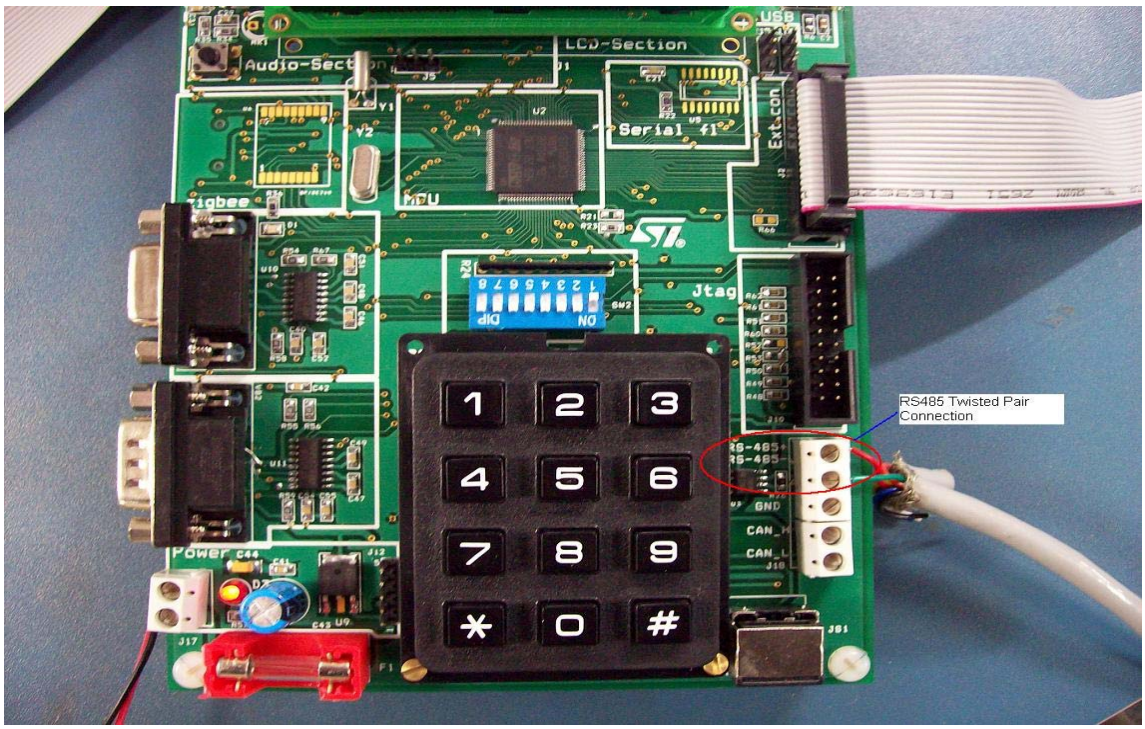
Step 10: Press F1 or F2 or F3 or F6 on keyboard (attached to master board) to select one of the above mentioned modes.

Step 11: Based on which of the above mentioned key is pressed, system will enter in one of the above mentioned modes. Operation in each mode is explained in section 4.

Step 12: Master control unit will send commands to slave control unit. Slave control unit will process these commands and configure the display panel for displaying entered data

Step 13: Press “ESC” on keyboard attached to master board to exit from present mode. After this system will resume from Step 9.If new address entered(for slave selection) matches with the slave address then slave display will be interrupted else display will continue will old data display.

Figure 7. RS485 Communication



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3.3 Multiple Control and Display Unit Configuration

In this configuration there are multiple control units and multiple display panels. One Control unit should be master and rests other are slave. By default system comes with one master and one display panel.

Below are the steps to operate the system in this configuration:

Step 1: Configure one control unit as Master and other control units as Slave as explained in section 2.1.2

Step 2: Configure the address of Slave boards using the onboard DIP switches as explained in section 2.1.1

Step 3: Connect PS2 keyboard to the master control unit

Step 4: Connect display panels to each Slave control unit using 20 pin flat ribbon cable. Insert the cable in 10 x 2 header **(Ext.Con)** present on slave at one side and in header J1 **(INPUT)** on display panel at other side.

If needed display panels can be cascaded in series to make a longer display. To cascade display panels connect 20 pin flat ribbon cable from jumper J3 **(OUTPUT)** of first panel to jumper J1 **(INPUT)** of second panel. Figure 6 shows connections for cascading of display panels. Similarly connect frc cable from jumper J3 **(OUTPUT)** of second panel to jumper J1 **(INPUT)** of third panel and so on to make a longer display. Up to 8 such display panels can be cascaded in series.

Step 5: Connect Master and Slave control units using twisted pair cable. Ensure that RS485+ at master is connected to RS485+ at slave and RS485- at master is connected to RS485- at slave. Connections are made at screw type connector (J18). Figure 8 shows the RS485 connection topology.

Step 6.Power up master control unit, slave control units and Display panels using DC power supplies. Please ensure in the case of cascading of display panels, power should be individually supplied at J5 screw type connector on each display panel.

Step 7: LCD on master and slave units will show “Press # to enter ConfigurationMod”. This will be displayed for 4 seconds. If master and slave boards are configured in Step 1 then don’t press “#” and boards will resume the functionality in 4 seconds

Step 8: Master control unit will start the demo showing “Led Matrix Demo” and slave control unit will start showing its own address.(Address is configured using on board switches).

Step 9: Display at master will start showing 4 options:

1) “Press F1 For PC – UART Comm”
2) “Press F2 For GPS Data Display”
3) “Press F3 For Typing Data”
4) “Press F6 For Demo Mode”

Step 10: Press F1 or F2 or F3 or F6 on keyboard to select one of the above mentioned modes.

Step 11: Based on which of the above mentioned key is pressed, system will enter in one of the above mentioned modes. Operation in each mode is explained in section 4.

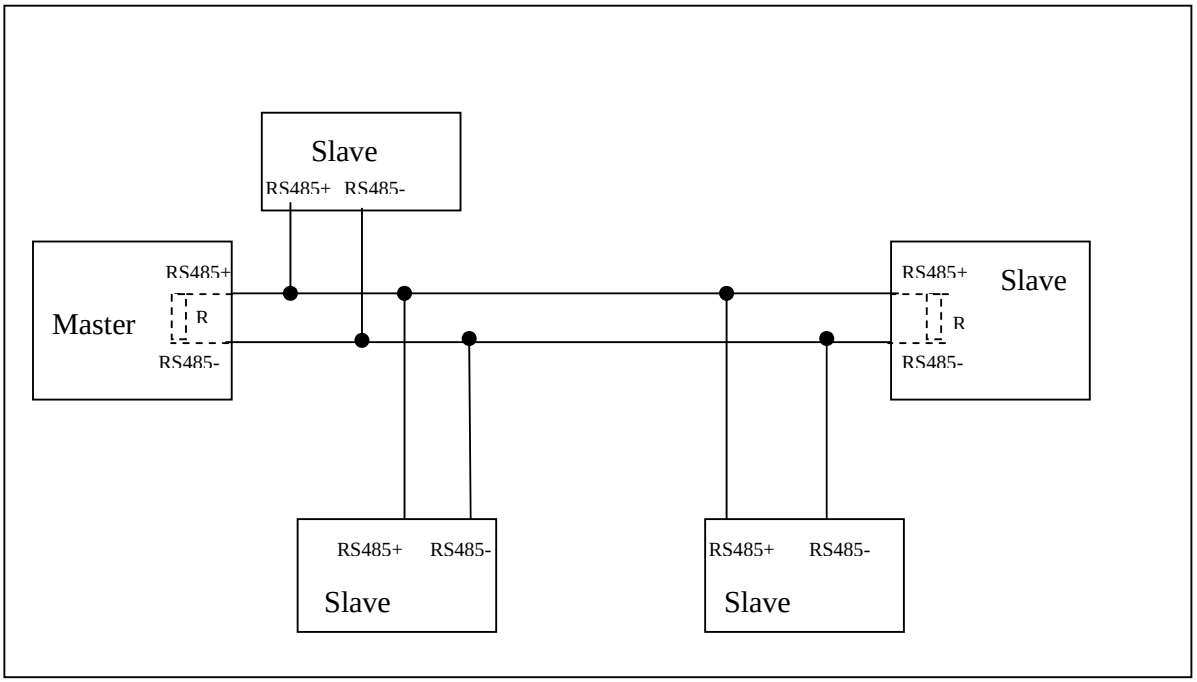
Step 12: Master board LCD will ask for address of slave control unit in order to configure the display unit

If the address entered at master unit matches with the slave unit then the selected slave unit can be configured for display else **“Address Mismatch”** is displayed over LCD and new address entry is requested.

Step 13: When address is matched then Master control unit will send commands to selected slave control unit. Slave control unit will process these commands and configure the display panel for displaying entered data. Rest other slave units will continue to display old data.

Step 14: Press “ESC” to exit from present mode. After this system will resume from Step 9.If new address entered(for slave selection) matches with the slave address then slave display will be interrupted else display will continue with old data.

Figure 8. RS485 Multi Drop Topology



Note: R is the termination resistance used for impedance matching

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4 Modes Of System Operation

LED Display demo board has 4 different modes of operation. These are:

1. PC-UART Communication Mode
2. GPS Module Communication Mode
3. Key Board Typing Mode
4. Demo Mode

As soon as master control unit is powered up, LCD on master board will show “MASTER BOARD” for first 2 seconds and then a menu will be started which ask for pressing F1/F2/F3/F6 for selecting one of the above mentioned modes.

4.1 PC-UART Communication Mode

Master control unit communicates with computer using UART communication protocol. Female DB9 connector on control unit is used to connect to a computer using serial connection cable.

Below are the steps to communicate using HyperTerminal of computer:

Steps:

1. Connect a serial cable between serial port of computer and female DB9 connector of master control unit (VB1)
2. Connect PS2 keyboard to master control unit.
3. Configure HyperTerminal on computer using following settings:

   Bits per Second: 115200

   DataBits: 8

   Parity: None

   Stop bits: 1

   Flow Control: None
4. Make the ASCII settings as shown in Figure 9.
5. Power up master control unit, LED Panel and also slave control unit (if connected)
6. LCD on master will show the menu program asking for **“Press F1 for PC-USART Comm”**
7. Press **“F1”** key on the keyboard attached to PS2 connector of master control unit
8. HyperTerminal will show a message

   -“USART HyperTerminal Communication Demo Maximum Allowed String Length is 200 Words”.

   - “Enter Display Board Address, Enter 1-255”
9. Enter the slave control unit address (as seen on LCD of slave control unit) or address of master(255) and then press “Enter” key on PC keyboard. Addresses allowed are between 1 and 255.
10. If the entered address is not present then there will be an error message on Hyper terminal **“Address Mismatch; Enter Display Board Address”.** Check the address of slave board and then re enter on hyper terminal.
11. When address is matched then Message on hyper terminal is **“Enter No. Of LED Boards”**. Enter number of LED display panels connected in cascade to the selected control unit.
12. Next message will be **“Enter Mode; Entr between 1-9”**. This is for entering one of 9 display modes. These modes are as followings:

a. Mode 1 => Curtain Up
b. Mode 2 => Curtain Down
c. Mode 3 = > Left To Right Scroll
d. Mode 4 => Right To Left Scroll
e. Mode 5 => Typing Data mode
f. Mode 6 => Stable Display
g. Mode 7 => Flashing mode
h. Mode 8 => Curtain Right
i. Mode 9 => Curtain Left

If the mode entered is other than 1-9 then default mode will be selected and message will be seen on terminal: **"Default Mode : Right To Left"**

13. As soon as mode is entered, selected mode will be seen on hyper terminal and then the next message will be **"Enter Speed; Entr between 1-9".** This speed is for seeing the display on LED Matrix. Speed 1 is fastest and 9 is slowest. If speed entered is other than 1-9 then default speed of 2 will be selected
14. Next message will be **"Enter String"**
15. Enter the string (maximum allowed string length is of 200 letters).When required string is entered, hit ENTER key on keyboard.
16. Data will be sent to LED Matrix display and can be seen over there.
17. Next message on hyper terminal will be **"Enter Y to Re-enter Display Mode Settings or any other key to Exit PC-UART mode:"** Thus if Y is entered then system will start from step 8. If any other key is entered then system will exit from PC-UART mode and normal menu will be seen on LCD of master control unit.

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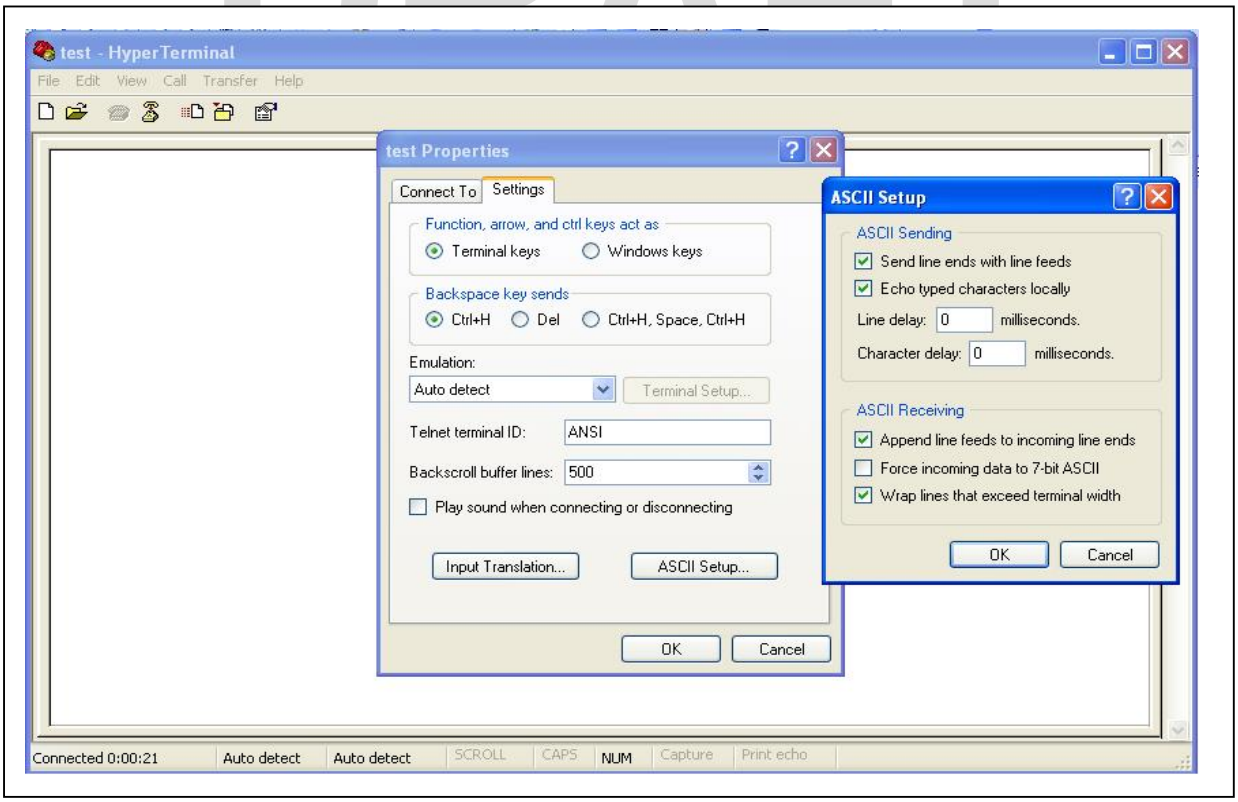
Figure 9. ASCII settings of Hyper terminal in Computer



4.2 GPS Communication Mode

Global Positioning System mode is used for interacting with externally connected GPS module and display Time, Latitude, Longitude and Satellite fixture status.

Below are the steps for communicating with GPS module:

Steps:

1. Connect a serial cable between GPS module and DB9 male connector (VB2) of master control unit. GPS systems should follow the handshaking protocol for serial communication.
2. Connect PS2 keyboard to master control unit.
3. Power up master control unit, LED Panel and also slave control unit (if connected)
4. LCD on master will show the menu program asking for **"Press F2 for GPS Data Display "**
5. Press **"F2"** key on the keyboard attached to PS2 connector of master control unit
6. LCD at master will show GPS mode selected and **"Enter Display Board Address"**. Enter the slave board address where data is to be displayed on LED Matrix panel. Addresses allowed are in between 1 and 255. 255 is fixed for master unit. If wrong data is entered then LCD will show **"Address Mismatch"** and will again ask for address
7. When address is matched then LCD will ask for entering the number of display panels connected in cascade at selected slave device.
8. As soon as number of display panels is entered, LED Matrix will start showing Time, Latitude, Longitude and Satellite fixture status on LED Matrix.
9. Press "**ESC**" on keyboard to exit from GPS mode and return to main menu.

4.3 Key Board Typing Mode

This mode is for user interaction using the key board attached at PS2 connector mother board.

Below are the steps for operating in Typing mode:

Steps:

1. Connect Key Board to PS2 connector on master control unit.
2. Power up master control unit ,LED Panel and slave control unit (if present)
3. LCD on master will show the menu program asking for **"Press F3 for Typing Data "**
4. Press **"F3"** key on the keyboard attached to PS2 connector of master control unit
5. LCD at master will show **"Enter Display Board Address"**. Enter the slave board address where data is to be displayed on LED Matrix panel. Addresses allowed are between 1 and 255.255 is fixed for master unit. If wrong data is entered then LCD will show **"Address Mismatch"** and will again ask for address
6. When Address is matched, LCD will show message **"Enter No. Of LED Boards".** Enter number of LED panels connected in cascade to the selected control unit
7. Next message will be **"Enter Mode; Entr between 1-9"**. This is for entering one of 9 display modes. Modes are explained in step 12 of section 4.1
8. As soon as mode is entered, selected mode will be seen on LCD and then will ask for **"Enter Speed; Entr between 1-9".** This speed is for seeing the display on LED Matrix. Speed 1 is fastest and 9 is slowest. If speed entered is other than 1-9 then default speed of 2 will be selected
9. Next message will be **"Enter String ; Pres ESC to exit"**
10. Enter the data which is to be seen on LED Matrix display. If user does not want to enter data and wants to exit from this mode, then "**ESC"** key should be pressed

11. As soon as data is entered, it will seen on LED Matrix and then LCD will show**"Pres ESC to exit; Enter to Proceed"**. Thus to continue with the Typing mode hit **"ENTER"** key on keyboard, system will switch to step 5 else hit **"ESC"** to exit from this mode and return to main menu.

Note: To check is Caps lock is ON or OFF see to the typed character on LCD. If Caps lock is ON then the alphabets will be seen in CAPITAL CASE on LCD else it will be in SMALL CASE.

4.4 Demo Mode

Demo mode will be executed with master control unit and display panel connected to **"Master unit"**.

This mode is supported with audio output.

Below are the steps for demo mode:

Steps:

1. Save an audio file in .wav format in micro SD card. Save the audio file with name "STN2". Configuration for audio file should be: 8Bit, 8kHz mono. This is the audio which will be heard from board.
2. Insert micro SD card in memory card slot connected at back side of master as shown in Figure 10.
3. Connect a display panel to master control unit using 20 pin flat ribbon cable.
4. Connect PS2 keyboard to master unit
5. Connect external speaker to two pin audio connector (near audio jack) or to audio jack. Audio jack is having a mono output only.
6. Power up master control unit and also the display panel.
7. Menu will be started on LCD. It will display **"Press F6 for Demo Mode"**. Press **"F6"** key to enter in Demo mode.
8. As soon as F6 is pressed, LCD will show message for entry of display panel number **"Enter No. Of LED Boards"**. Enter number of display panel connected to master unit.
9. After number of led panels is entered audio file saved as STN2 in micro SD card will be played on speaker and LED panel will show a message"**Wish You A Happy Journey"**.
10. Press **"ESC"** key on key board to exit from this mode and go back to menu.

Note:For DEMO mode, microSD card should be insetred in the card slot else no data display will occur.ESC key is used to exit from this mode at any point of time.

Note: At any point of system press twice the ESC key on key board attached to master unit to return back to main menu.

Note: Untill we enter one of the Modes of system pressing of any key (other than F1/F2/F3/F6) will show a message of "Key Not Allowed".

Note: In PC USART mode key board attached to mother unit will not be active for data entry.Only ESC key will be functional in this mode.

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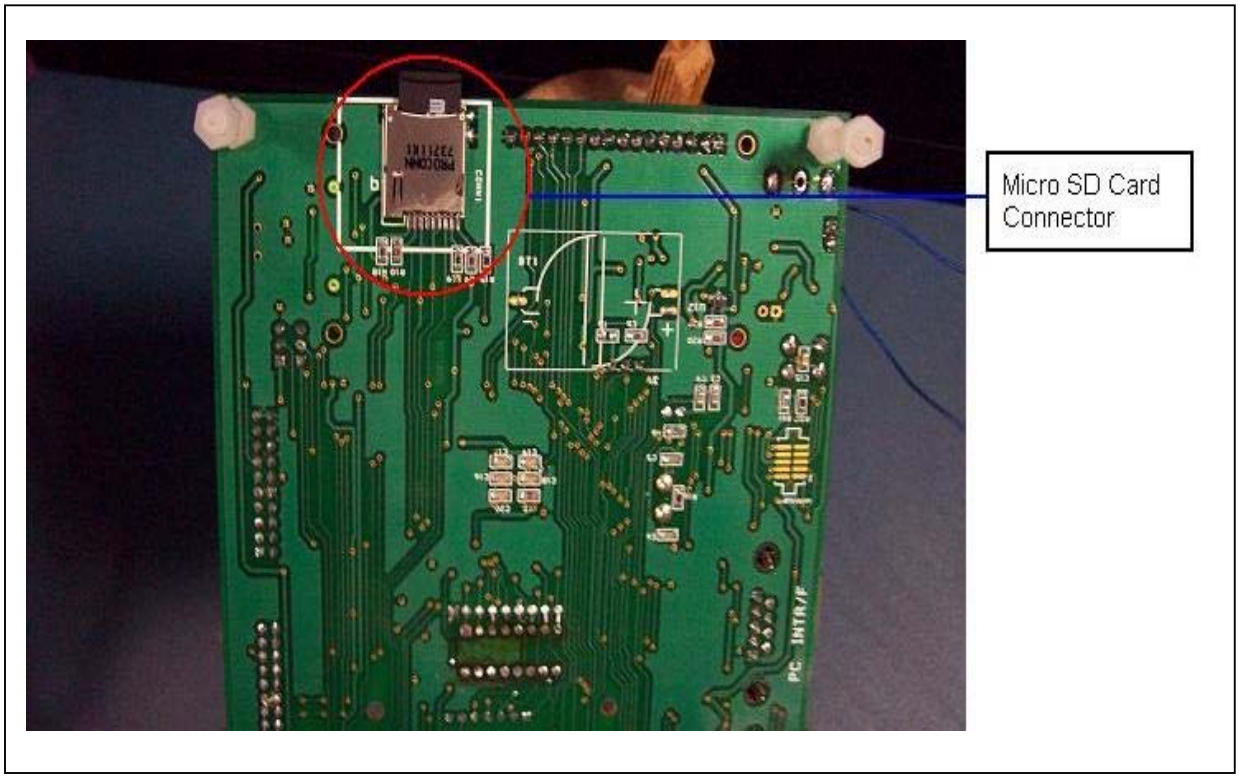
Figure 10. Micro SD card Connection



5 Schematic

STM32 based display driver demo schematic is made in 2 parts. First one is for microcontroller based control unit and second is for LED display panel. Figure 11 shows the schematic for control unit and figure shows the schematic for display panel.

Figure 11 Schematic for Control Unit

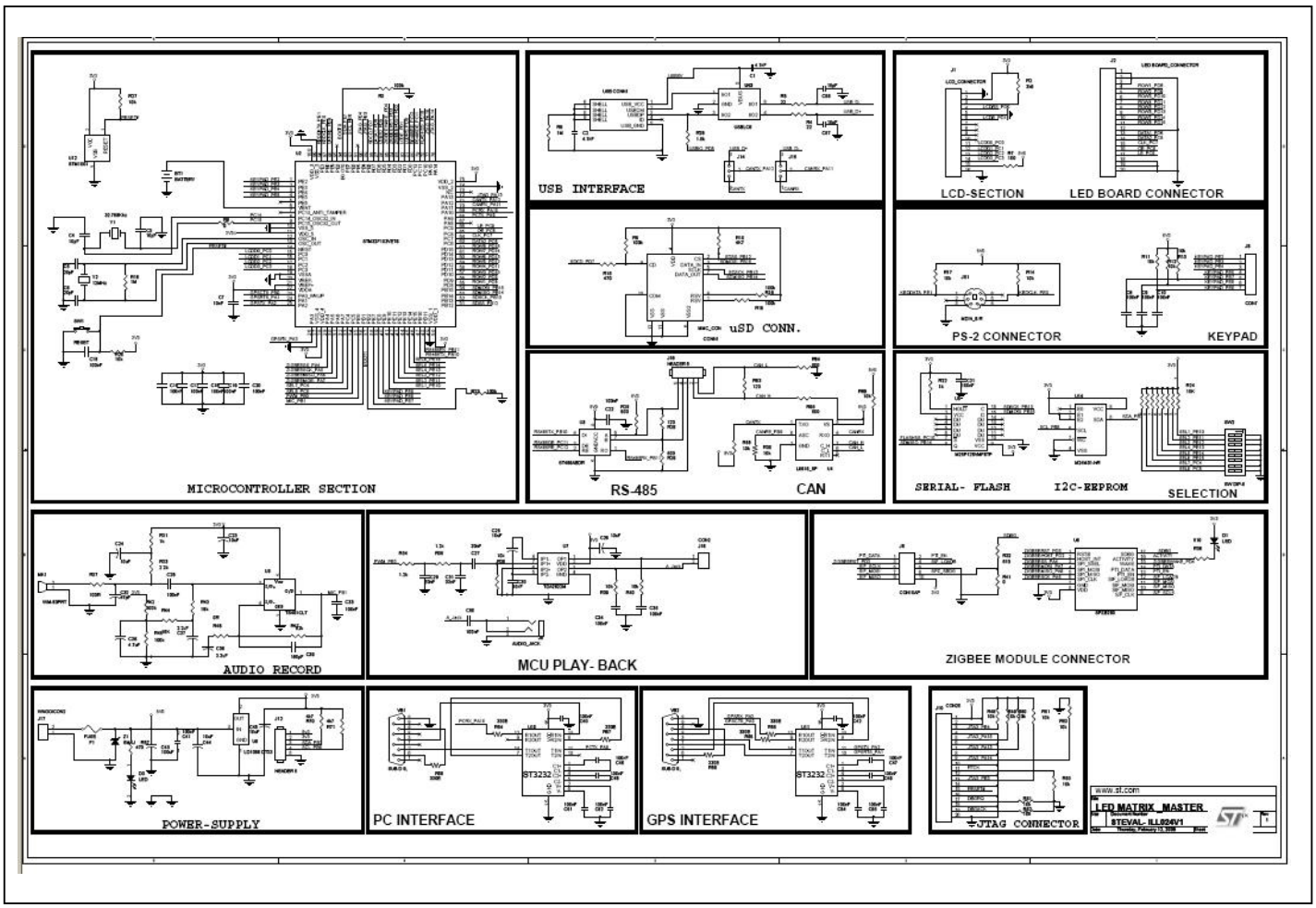
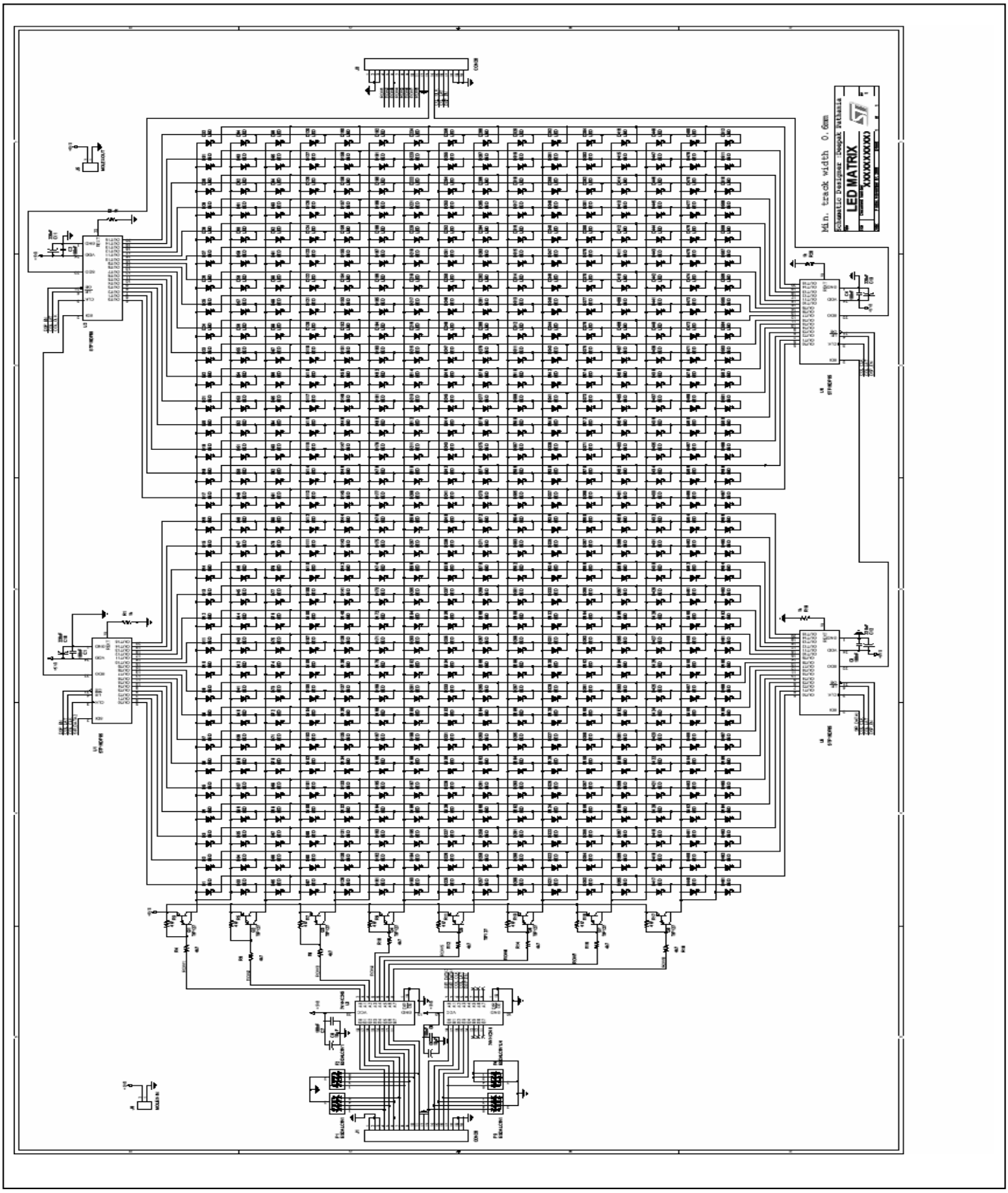


Figure 12 . LED Display Panel Schematic



6 BOM

Table 1.BOM Of Microcontroller based Control Unit

Reference Designator	Component Description	Package	Manufacturer	Manufacturer's ordering code / Orderable Part Number	Supplier	Supplier Ordering Code	Quantity
U2	STM32F103VBT6/Microcontroller	LQFP	ST	STM32F103VBT6			1
U3	ST485ABDR	SO8	ST	ST485ABDR			1
U4	L9615D/CAN Transceiver	SO8	ST	L9615D			1
U5	M25P128VMF6TP/SerialFlash	SO16	ST	M25P128VMF6TP			**Not Mounted**
U6	SPZB260/Zigbee Moudule		ST	SPZB260			**Not Mounted**
U7	TDA2822D/Post Amplifier	SO8	ST	TDA2822D			1
U8	TS461CLT/Rail to rail op amp	SOT23-5L	ST	TS461CLT			1
U9	LD1086DT33TR/Voltage Regulator	DPAK	ST	LD1086DT33TR			1
U10,U11	ST3232CDR/RS3232 Driver Receiver	SO 16	ST	ST3232CDR			2
U12	STM1001RWX6F/Reset Ic	SOT23-3	ST	STM1001RWX6F			1
U13	USBLC6-2P6	SOT-666	ST	USBLC6-2P6			1
U14	M24M01-HWMN6TP/EEPROM	SO8	ST	M24M01-HWMN6TP			**Not Mounted**
Z1	STPS1L30A/Schottky Rectifier	SMA	ST	STPS1L30A			1
Y1	32.768kHz	XTAL-3	ECS	ECS-327-18-9X	Mouser	520-ECS-3276-18-9X	1
Y2	8Mhz	XTAL-3	Fox	FOXSLF/080-20	Mouser	559-FOXS080-20-LF	1
USB CONN1	USB-B Type Mini Connector	SMD	Molex	67503-1020	Mouser	538-67503-1020	1
VB1	DB9 Connector/Female	through hole	Tyco Electronics	5747844-4	Mouser	571-5747844-4	1
VB2	DB9 Connector/Male	through hole	Tyco Electronics	5747840-4	Mouser	571-5747840-4	1
J1	LCD Connector and 16 x 2 alphanumeric LCD	16 x 1Bergstrip	Oriole	ODM16216-9SL3/AX	Oriole		1
J2	LED Board connector	10 x 2 header	Molex	70246-1001	Mouser	538-70246-1001	1

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J5,J14,J15	3 PIN Berg Strip	3 x 1 Bergstrip	Any		Samtec	TSW-150-32-G-S	3
J6	7 PIN Berg Strip and Keypad	7 x1 pin Bergstrip	Any		Futurlec	KEYPAD3X4B	1
J8	8 pin header/zigbee header	8 pin header	Any				**Not Mounted**
J9	Audio Jack	3 pin through hole	CUI	SJ1-3523NG	Digikey	CP1-3523NG-ND	1
J10	Jtag Connector	10 x 2 header	Molex	70246-1001	Mouser	538-70246-1001	1
J12,J16	Berg Strip/Jumers	5 x 1Bergstrip	Any		Samtec	TSW-150-32-G-S	1
J18	screw type connector	through hole	Phoneix Contact	1729131	Mouser	651-1729131	1
CONN1	MMC card connector	smd	Proconn Technology	MSPN09-X0-1000			1
J17	screw type connector	through hole	Phoneix Contact	1729128	Mouser	651-1729128	1
D1,D3	LED-Red	LED-3mm	Everlight	EL-204HT	Mouser	638-204HT	2
C1,C2	4.7nF	SMD0805	Panasonic - ECG	ECJ-2VB1H472K	Digikey	PCC472BNTR-ND	2
C3,C4,	10pF	SMD0805	Panasonic - ECG	ECJ-2VC1H100D	Digikey	PCC100CNTR-ND	2
C5,C6	20pF	SMD0805	Murata Electronics North America	GQM2195C1H200JB01D	Digikey	490-3607-2-ND	2
C7,C30	10nF	SMD0805	Panasonic - ECG	ECJ-2VB1H103K	Digikey	PCC103BNTR-ND	2
C8,C9,C10,C15,C16,C17,C18,C19,C20,C21,C22,C28,C33,C34,C35,C40,C41,C42,C46,C47,C48,C49,C50,C51, C52,C53, C54,C55	100nF	SMD0805	Panasonic - ECG	ECJ-2VB1E104K or equivalent	Digikey	PCC1828CT-ND	28
C23,C24, C25,C26, C44,C45	10uF	Case A	Vishay/Sprague	293D106X96R3A2TE3 or equivalent	Mouser	74-293D106X96R3A2TE3	6
C27,C29, C31	33nF	SMD0805	Panasonic - ECG	ECJ-2VB1H333K	Digikey	PCC1834TR-ND	3
C32	47pF	SMD0805	Panasonic - ECG	ECJ-2VC1H470J	Digikey	PCC470CGTR-ND	1

C36	4.7uF	SMD0805	Panasonic - ECG	ECJ-2YF1A475Z	Digikey	PCC1842TR-ND	1
C38	3.3uF	SMD0805	Panasonic - ECG	ECJ-2FB1A335K	Digikey	PCC2288TR-ND	1
C39	180pF	SMD0805	Panasonic - ECG	ECJ-2VC1H181J	Digikey	PCC181CGTR-ND	1
C43	100uF	through hole	TDK Corporation	FK22X5R0J107M	Digikey	445-2902-ND	1
C56,C57	15pF	SMD0805	Panasonic - ECG	ECJ-2VC1H150J	Digikey	PCC150CNTR-ND	2
R1,R3,R9,R18,R19,R21,R23,R42, R45	988k	SMD0805	Stackpole Electronics Inc	RNC 20 T2 988K 0.1% R	digikey	RNC20T2988KBR-ND	9
R2	3k5	SMD0805	Stackpole Electronics Inc	RNC 20 T9 3.52K 0.1% R	digikey	RNC20T93.52KBR-ND	1
R4,R5	22	SMD0805	Panasonic - ECG	ERJ-6GEYJ220V	digikey	P22ATR-ND	2
R6,R16	1M	SMD0805	Panasonic - ECG	ERJ-6GEYJ105V	digikey	P1.0MATR-ND	2
R7	100	SMD0805	Panasonic - ECG	ERJ-6GEYJ101V	digikey	P100ATR-ND	1
R8,R41, R46	0	SMD0805	Panasonic - ECG	ERJ-6GEY0R00V	digikey	P0.0ATR-ND	3
R10,R70, R71	4k7	SMD0805	Panasonic - ECG	ERJ-6GEYJ472V	digikey	P4.7KATR-ND	3
R11,R12, R13,R14, R17,R20, R27,R30, R38,R39, R40,R48, R49,R50, R51,R53, R60,R61, R62,R68, R69	10k	SMD0805	Panasonic - ECG	ERJ-6GEYJ103V	digikey	P10KACT-ND	21
R24	10k/ Resistor bank(9 PIN)	SIP9	BI Technologies	L091C103LF	Mouser	858-L091C103LF	1
R15,R57	470	SMD0805	Panasonic - ECG	ERJ-6GEYJ471V	digikey	P470ATR-ND	2
R22,R31	1k	SMD0805	Panasonic - ECG	ERJ-6GEYJ102V	digikey	P1.0KATR-ND	2
R25,R29, R64,R65	499	SMD0805	Panasonic - ECG	ERJ-6ENF4990V	digikey	P499CTR-ND	4
R26,R63	120	SMD0805	Panasonic - ECG	ERJ-6GEYJ121V	digikey	P120ATR-ND	2
R28	1.5k	SMD0805	Panasonic - ECG	ERJ-6GEYJ152V	digikey	P1.5KATR-ND	1
R32,R36	510	SMD0805	Panasonic - ECG	ERJ-6GEYJ511V	digikey	P510ATR-ND	2

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R33	2.2k	SMD0805	Panasonic - ECG	ERJ-6GEYJ222V	digikey	P2.2KATR-ND	1
R34,R35	1.2k	SMD0805	Panasonic - ECG	ERJ-6GEYJ122V	digikey	P1.2KATR-ND	2
R37	100	SMD0805	Panasonic - ECG	ERJ-6GEYJ101V	digikey	P100ATR-ND	1
R43	18k	SMD0805	Panasonic - ECG	ERJ-6GEYJ183V	digikey	P18KATR-ND	1
R44	15k	SMD0805	Panasonic - ECG	ERJ-6GEYJ153V	digikey	P15KATR-ND	1
R47	82k	SMD0805	Panasonic - ECG	ERJ-6GEYJ822V	digikey	P8.2KATR-ND	1
R52	DO NOT MOUNT						**Not Mounted**
R54,R55, R56,R58, R59,R67	330E	SMD0805	Panasonic - ECG	ERJ-6GEYJ331V	digikey	P330ATR-ND	1
R66	DO NOT MOUNT	SMD0805	Any				**Not Mounted**
SW1	Push Button RESET switch	through hole	E-Switch	TL1105F250Q	Mouser	612-TL1105-250	1
SW2	DIP 8 switch	through hole	C&K Components	BD08	Mouser	611-BD08	1
JS1	Mini Din/key board connector	through hole	Kobiconn	161-2306	Mouser	161-2306	1
F1	1 amp Fuse connector + Fuse	through hole	Keystone Electronics	0217.500HXP + 4527C	Mouser	576-0217.500 HXP + 534-4527C	1
BT1	Coin Battery connector	through hole	Any				**Not Mounted**

Table 2. BOM of LED Display Panel

Reference Designator	Component Description	Package	Manufacturer	Manufacturer's ordering code / Orderable Part Number	Supplier	Supplier Ordering Code	Quantity
U1,U2,U5,U6	STP16DP05MTR/Display driver	SO24	ST	STP16DP05MTR			4
U3,U4	74VHC245MTR	SOP20	ST	74VHC245MTR			2
Q1,Q2,Q3,Q4,Q5,Q6,Q7,Q8	TIP127	TO-220	ST	TIP127			8
P1,P2,P3,P4	ESDALC6V1W5/Quad transil	SOT323-5L	ST	ESDLALC6V1W5			4
J1,J3	10 X 2 HEADER	10 X 2 BOX HEADER	Molex	70246-1001	Mouser	538-70246-1001	2
J5,J6	2 pin Molex Connector	2 PIN Through hole	Phoenix Contact	1729128	Mouser	651-1729128	2
D1 to D512	PLC	SMD	LS T676-R1S1-1-Z	Osram	Digikey	475-2683-1-ND	512
C1,C2,C3,C4,C6,C7	100nF	SMD0805	Panasonic - ECG	ECJ-2VB1E104K or equivalent	Digikey	PCC1828CT-ND	6
C5,C10	10uF	Case A	Vishay/Sprague	293D106X96R3A2TE3 or equivalent	Mouser	74-293D106X96R3A2TE3	2
C8,C11,C12,C13	220uF	SMD0805	Nichicon	UKW1E221MPD	Mouser	647-UKW1E221MPD	4
R1,R2,R19,R20	1k	SMD0805	Xicon	292-1.0K-RC or equivalent	Mouser	292-1.0K-RC	4
R3,R4,R5,R6,R7,R8,R9,R10,R11,R12,R13,R14,R15,R16,R17,R18	4k7	SMD0805	Xicon	292-4.7K-RC or equivalent	Mouser	292-4.7K-RC	16

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7 Revision History

Revision	Date of modification	Description of modification
1.0	December 2, 2008	Initial draft